July 4, 1961 J. BOCHAN 2,990,705

ARTICLE-TREATING MACHINE WITH FLUID-OPERATED SWITCH CONTROLS THEREFOR

Filed June 15, 1960 2 Sheets-Sheet 1

FIG. 1

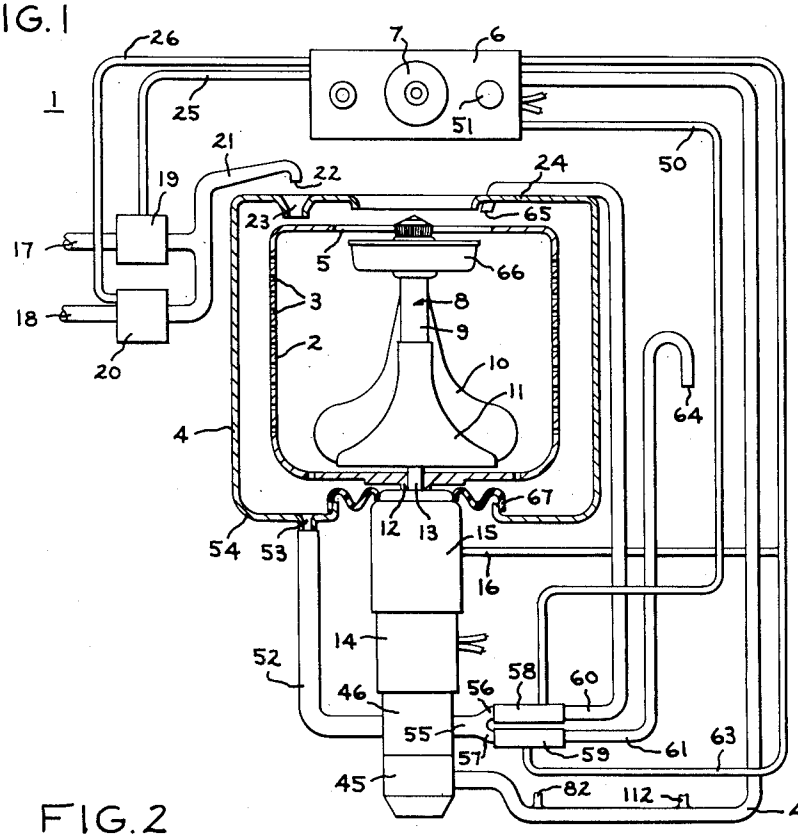


FIG. 2

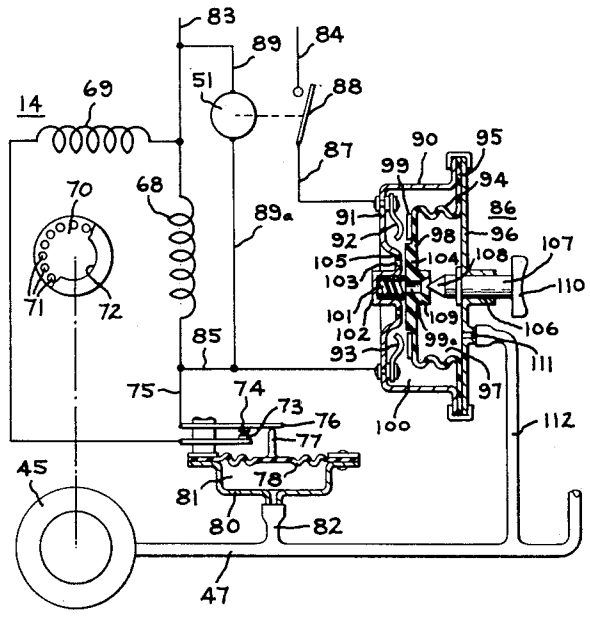
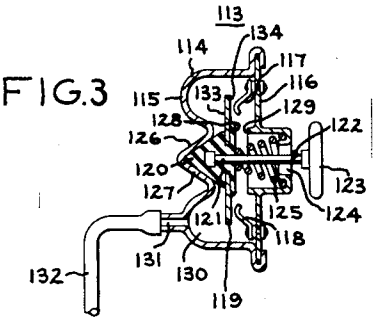


FIG. 3



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ARTICLE-TREATING MACHINE WITH FLUID-OPERATED SWITCH CONTROLS THEREFOR

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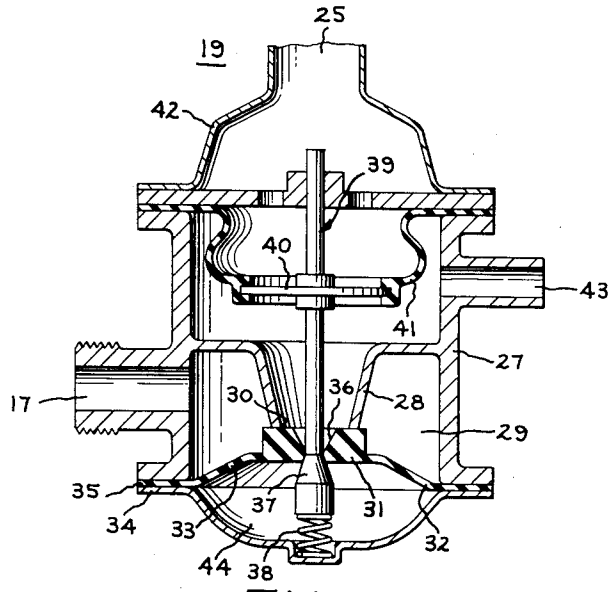


FIG. 4

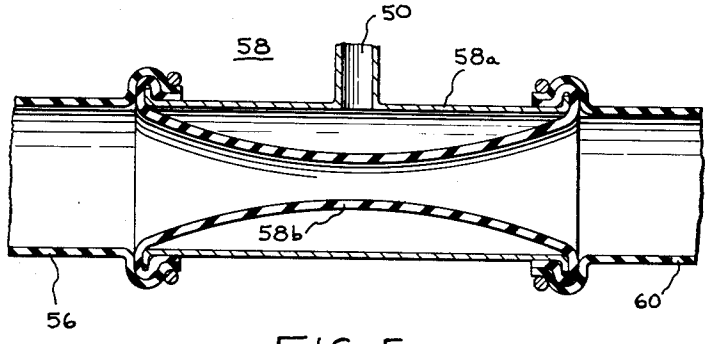


FIG. 5

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2,990,705

ARTICLE-TREATING MACHINE WITH FLUID-OPERATED SWITCH CONTROLS THEREFOR

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Filed June 15, 1960, Ser. No. 36,429
18 Claims. (Cl. 68—12)

This invention relates to article treating machines such as, for instance, clothes washing machines, and more particularly to a system including pneumatic switch components for controlling the treating of articles in such machines.

At the present time, article treating machines such as, for instance, clothes washing machines, have control arrangements which are primarily electrical throughout, generally involving the use of solenoids and the like. Inasmuch as solenoids always have the basic function of moving a controlling member from one position to another, it is readily apparent that a fluid-operated system wherein the pressure of a fluid such as air takes the place of the electromagnetic force may be utilized for the movement of the control members. Such a system, it is being found, has the advantage that many components of the machine may be substantially simplified over the structure required for an all electric control system.

It is, therefore, an object of my invention to provide an article treating machine such as, for instance, a clothes washing machine wherein the electrical means which is conventionally provided for driving the article treating means is subject to fluid control.

A further object of my invention is to provide such an arrangement wherein an electric driving motor in such a machine is energized through a circuit controlled by such fluid-operated structure, with the structure being locked in place once it is manually positioned in its circuit completing position and the motor is operating.

A more specific object of my invention is to provide such a structure wherein the motor is of the conventional induction type having a main winding and a start winding and wherein the connection and disconnection of the start winding is fluid-controlled responsive to operation of the motor.

A further object of my invention is to provide improved fluid-operated switch means for effecting the above-mentioned locking in of the electric motor in an energizing circuit as long as the motor operates.

A further object of my invention, in one embodiment thereof, is to provide means whereby, through the use of fluid-operated switch means, the above-mentioned electric motor may be de-energized upon the provision of force exerted in virtually any direction of a manually movable member.

In one aspect of my invention, I provide an article treating machine having an article container with suitable means for treating articles which are in the container, and with suitable drive means for operating the treating means. The drive means includes an electric motor which also operates a fluid compressor, and the motor is adapted to be energized through an appropriate circuit across a suitable source of power. The energizing circuit for the motor includes suitable switch means wherein a pair of contacts control completion of the circuit, and are in turn controlled by a movable structure which in one position provides electrical connection of the contacts and in another position electrical separation of the contacts. The movable structure is biased to the position in which it disconnects the contacts, and is provided with manual means by virtue of which the structure may be moved to its connecting position. Means are cooperably positioned relative to the movable structure so as to form

therewith a closed chamber when the movable structure is in contact-connecting position and so as to vent the chamber when the movable structure is in its disconnecting position. The compressor means driven by the motor is connected by suitable conduit means to the chamber, and the movable structure is so formed that, when it is in its second position and the motor is operating the compressor, the pressure within the chamber acts on the structure in opposition to the bias on the structure so as to retain the structure in its second position and keep the motor energizing circuit closed.

With the above combination of elements, the drive motor of the article treating machine will continue to operate once the movable structure has been moved to its second contact connecting position until such time as the motor fails to operate for any reason, either by malfunction or by virtue of separate controlling means opening the circuit. It will be observed that the foregoing structure, in addition to including an ingenious combination of cooperating and interlocking elements, also provides, as an important subcombination, a switch structure which is fluid-operated to effect the desired results.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawing.

In the drawing,

FIGURE 1 is a schematic side elevational representation of a fluid-controlled article treating machine, more specifically, in this case, a clothes washing machine;

FIGURE 2 is a schematic representation of the controlling circuit for the motor which operates the treating means in FIGURE 1;

FIGURE 3 is a cross-sectional side elevational view of a modification of the improved fluid-operated switch structure of my invention;

FIGURE 4 is a cross-sectional side elevational view of a typical fluid-operated pilot valve as used in the machine of FIGURE 1; and

FIGURE 5 is a cross-sectional side elevational view of a typical fluid operated drain valve as used in the machine of FIGURE 1.

Referring now to FIGURE 1, I have shown therein an agitator-type clothes washing machine, generally indicated by the numeral **1**, with the conventional basket **2** which may be provided with perforations **3** and is disposed within an outer imperforate tub or casing **4**. It will be understood that the entire structure of FIGURE 1 is conventionally mounted within a suitable appearance cabinet (not shown) with a suitable access opening to permit the insertion of clothes into basket **2** through the opening **5** in the top thereof. The cabinet also normally supports a suitable controlling structure, generally indicated by the numeral **6**, provided with a suitable manual cycle control and indicating structure **7** in the conventional manner.

At the center of basket **2** there is positioned a vertical axis agitator **8** which includes a center post **9** and a plurality of water circulating vanes **10** joined at their lower ends by an outwardly flared skirt **11**. Both the clothes basket **2** and the agitator **9** are rotatably mounted. The basket is mounted on an outer shaft **12** and the agitator **9** is mounted on an inner shaft **13** which is rotatably secured relative to the outer shaft **12**. During the cycle of operation of the machine **1**, the agitator conventionally is first oscillated back and forth on its axis in a horizontal plane by the shaft **13** within the basket **2** to wash the clothes therein after the introduction of a washing liquid. Then, after a predetermined period of this washing ac-

tion, the basket 2 is rotated at high speed through shaft 12 to extract centrifugally the washing liquid from the clothes and discharge it to drain, as will be explained. Following this extraction operation, a supply of clean liquid is introduced into the basket for rinsing the clothes and the agitator is again oscillated. Finally, the basket is once more rotated at high speed to extract the rinse water.

The basket 2 and agitator 8 may be driven through any suitable transmission from a motor schematically indicated at 14. The motor 14 drives the basket and agitator through a suitable transmission assembly 15 provided with a pneumatic connection 16 to control 6. Transmission 15 is so arranged that it supports and drives both the agitator drive shaft 13 and the basket mounting shaft 12. When there is no fluid pressure transmitted to transmission 15 through hose 16, the transmission causes the agitator 8 to oscillate in a substantially horizontal plane within the basket 2. Conversely, when pressure is supplied through hose 16, the transmission rotates basket 2 and agitator 8 together at high speed for centrifugal extraction. While the specific form of the transmission forms no part of the invention of this application and a detailed description of the transmission would merely complicate this disclosure without clarifying my invention, reference is made to Patent 2,462,657 issued to Jacob W. McNairy on February 22, 1949, and owned by the General Electric Company, assignee of the present invention. That patent discloses in detail the structural characteristics of a fluid-drive transmission assembly suitable for use in the illustrated machine, the only variation being that I prefer to utilize pneumatic controls rather than electric controls; since, in the McNairy patent, inflation of a bellows provides spin and deflation thereof provides agitation, it will be obvious that I may effect this result by controlling the pressure transmitted through hose 16 and by connecting the hose to the bellows of the McNairy structure. The control of the pressure in hose 16 is further described herebelow.

In order to introduce fresh water to the machine, suitable conduits 17 and 18 leading respectively to hot and cold water sources (not shown) are provided, and each of these two conduits lead respectively into a pair of valves schematically shown by the numerals 19 and 20. Valves 19 and 20 control the flow of hot and cold water respectively into a conduit 21 having an outlet 22 positioned in spaced relationship over an opening 23 formed in the top flange portion 24 of tub 4 so that suitable supplies of hot, cold or warm water may be introduced in the desired quantities into the tub 4 and basket 2. While the plungers in such valves are commonly controlled at the present time by electrical means such as solenoids I prefer, in my contemplated structure, to control the movement pneumatically, and for this purpose I provide air conduits 25 and 26 respectively to valves 19 and 20 so that when air is supplied under pressure through these conduits to the valves they cause the valves to open and when the supply of air under pressure ceases, the valves close.

In this connection, reference is made to FIGURE 4 showing valve 19. The valve includes a casing 27 with which the inlet 17 communicates, the casing having a portion 28 formed so as to provide a chamber 29. Portion 28 of the casing also forms an opening 30 which is normally closed by portion 31 of a diaphragm member 32 provided with a relatively small bleed opening 33 and secured in place by any suitable means such as a cover member 34 which clamps the edge 35 of the valve in position. The diaphragm 32 has a central opening 36 which is normally closed by a member 37 biased into the opening by a spring 38 secured against the retainer member 34. Valve member 37 forms part of an assembly, generally indicated by the numeral 39, which is secured by a portion 40 to a bellows member 41 so as to form, together with portion 42 of the housing, a substantially enclosed chamber communicating with the air inlet 25.

It will be observed that, in the conventional manner of pilot-operated valves, no liquid can flow from conduit 17 to the outlet 43 of the valve so long as the diaphragm 32 is in the position shown. During periods of closure, the space 44 on the outside of diaphragm 32 is filled with water since it leaks through the bleed opening 33 from the inlet 17. However, when because of pneumatic pressure coming through conduit 25, the bellows 41 is expanded, this moves the valve member 37 out of its closing position against the action of the spring 38, and as a result liquid can flow down through opening 36 toward the outlet 43. When this happens, because of the relatively small amount of flow which can pass through opening 33 the pressure above diaphragm 32 is greater than the pressure therebelow, and the diaphragm is pushed downwardly or away from the opening 30 so that the full flow of water can then pass from inlet 17 through the opening 30 to the outlet 43.

When it is desired to stop the flow through the valve, the air pressure through inlet 25 is removed; as a result, the spring 38 returns the valve 37 to closed position. The water coming through opening 33 then slowly equalizes the liquid pressure above and below the diaphragm 32 and the diaphragm is returned by spring 38 to the position in which it closes opening 30. It will be recognized that the operation of valve 19 is substantially the same as conventional pilot operated valves used commercially at the present time with the single exception that instead of a solenoid operated assembly operated from the high pressure side of the system there is used, instead, a pneumatically operated arrangement which effects its operation from the low pressure side of the valve. It will further be understood that the structure of valve 20 may be the same as that of valve 19 so as to operate in the same manner, providing flow when a suitable amount of pressure is provided through the air conduit thereto and preventing flow when this pressure is removed.

Motor 14, in addition to driving the transmission 15, is directly connected both to an air compressor 45 and a pumping mechanism 46 so as to drive both the compressor and the pump continuously during its operation. It will readily be understood that both the compressor 45 and the pump 46 may be of the conventional structure well known in the art and that therefore the particular internal construction of each is not described herein.

The operation of compressor 45 by motor 14 causes air to be pulled in and compressed. This relatively high pressure air, which may, for instance, be on the order of 10 p.s.i.g., passes from the air compressor 45 through a conduit 47 into the control member generally indicated at 6. It will be understood that the control 6 may be of the conventional type which is in commercial use in many instances in, for instance, industrial laundering operations. For instance, one such control is briefly described on page 58 of the text book entitled "Industrial Detergency" by Wm. W. Niven, Jr., published in 1955 by Reinhold Publishing Corporation (see the paragraph starting immediately below FIGS. 4—3 on the cited page). In this type of control (not illustrated herein since it is not part of applicant's invention), a roll of material is positioned in the path of the incoming air from conduit 47 and connections are provided to the different outlets 16, 25, 26, and 50 which come out of the control 6 in order to control different components of the machine. The roll of material has suitable openings to allow the air under pressure to pass through to the different components at the appropriate times in the cycle (in the manner of a player piano), and is rotated by any suitable means such as a small synchronous motor, schematically indicated by the numeral 51. In this way, the passage of the roll and the position of the openings therein control the functioning of the different components of the machine, causing it to pass through an entire cycle to provide the various operations described above, and then shutting off the machine. Thus when

operation of motor **14** is started to cause compression of air by the compressor **45**, and operation of motor **51** is also started, the machine will proceed through an entire cycle under the control of the sequence control device **6**.

The pump **46** has its inlet connected to a flexible conduit **52**, which in turn is connected to an opening **53** formed in the bottom **54** of tub **4** so that water flows from the bottom of the tub **4** down through conduit **52** into pump **46**. A conduit **55** is connected to the outlet of pump **46** and splits into two different portions **56** and **57** leading respectively to valves schematically illustrated at **58** and **59**. Valves **58** and **59** respectively have connected to their outlets conduits **60** and **61**, and are respectively controlled through air hoses **50** and **63**, hose **50** extending directly from control **6** and hose **63** being joined to the control through hose **16**. While the valves **58** and **59** may be of any conventional pneumatically operated type, one well known structure of this type is shown in FIGURE 5. In that figure, there is shown the valve **58** wherein a rigid outer tubular member **58***a* is provided. Within member **58***a* is positioned a flexible tubular member **58***b* secured at its ends to the rigid tubular member. When pneumatic pressure is applied through hose **50**, it collapses member **58***b* to prevent flow therethrough. Removal of the pressure in line **50** permits member **58***b* to resume its normal open position so that liquid can be drained therethrough. Thus, valves **58** and **59** represent structures wherein the provision of air pressure to the valve causes the flow of liquid therethrough to be cut off, and the removal of air pressure permits flow of liquid through the valve.

When valve **58** is closed and valve **59** is opened, the liquid passing from the tub **4** through pump **46** is passed through the valve **59** to conduit **61** and then out through a suitable drain (not shown) positioned to receive the output from the outlet **64** of the drain conduit **61**. However, when valve **59** is closed and valve **58** is opened the water passes from pump **46** through the valve **58** and then through conduit **60** and from the outlet **65** thereof into a filter pan **66** and back into the basket **2** and tub **4**. Such a filtering structure is described in full detail and is claimed in Patent 2,481,979 issued on September 13, 1949, to R. S. Colley and assigned to General Electric Company, assignee of the present invention.

It will thus be seen that with only valve **59** open, the water is removed from the tub and basket and passed to drain, while with the valve **58** only being open, the water is continually circulated and filtered. It is contemplated, of course, that valve **58** is maintained open and valve **59** closed during washing and rinsing operations so as to retain the water within the tub and basket and that valve **59** is open and valve **58** is closed during spinning operations so as to provide for removal of the water being spun out of the clothes contained with the basket **2**.

Tub **4** is joined at its lowest section to the transmission **16** by a flexible boot member **67**. This permits the motion between the tub and the agitator, basket and transmission which frequently occurs during spinning operations, particularly because of unbalanced clothes distribution within the basket **2**. It is contemplated that in the conventional manner, although not shown, the tub **4** may be secured to the rigid components of the machine while the basket, agitator and the components secured to the basket are flexibly mounted on the rigid parts of the machine. Also, of course, all hose and conduit connections extending between rigidly secured parts and flexibly secured parts are preferably flexible in order to allow for relative motion thereof.

Having described the general structure of the machine and the interrelation of the various components thereof, reference will now be made to FIGURE 2 to describe an embodiment of the inventive combination provided for use in the structure of FIGURE 1. In FIGURE 2, the motor **14** is schematically shown as a conventional induction-type motor having a stator with a main winding **68** and a start winding **69**, and a rotor schematically indicated by the numeral **70**. Both stator and rotor are conventionally formed in the same manner of a stacked plurality of laminations of magnetic material. In rotor **70** conductors **71** extend through the stack and are joined at their ends by suitable end rings **72** to form a squirrel-cage winding.

As is also shown schematically and as is described in connection with FIGURE 1, the rotor **70** of motor **14** is connected to the compressor **45** so that when the rotor is in operation there is also operation of the air compressor to cause the passage of air under pressure through conduit **47** to the various machine components to be operated. The start winding **69** of the motor is connected through a pair of contacts **73** and **74** to a conductor **75**, so that when the contacts **73** and **74** are in engagement with each other the start winding **69** is connected in parallel with main winding **68** and when the contacts are separated the start winding is removed from the circuit. While contact **73** is stationary, contact **74** is positioned to be movable, and for this purpose it is secured on a movable arm **76** which is engaged by a projection **77** formed on a diaphragm **78**. Diaphragm **78** is secured to and cooperates with a switch casing member **80** to form a substantially enclosed chamber **81**, and this chamber is connected to the air compressor **45** through hose **47** and a hose **82** which connects hose **47** to the interior of chamber **81**.

When there is no pressure within chamber **81** because the compressor **45** is not operating, the contacts **73** and **74** are in engagement. However, when the motor **14** is started, as will be more fully explained herebelow, the rotation of the rotor is transmitted to air compressor **45** and this in turn raises the pressure within chamber **81**, the pressure increasing as the speed of rotation of the compressor comes up to its expected value. The components are designed so that at a suitable speed below the maximum speed, the pressure within chamber **81** is sufficient to move diaphragm **78** upwardly with the result that through this upward movement projection **77** moves arm **76** upwardly to separate contact **74** from the contact **73**. This then breaks the start winding circuit and the motor may continue to run on the main winding **68** alone in the conventional manner.

The energizing circuit for motor **14** is provided through a pair of conductors **83** and **84** which are intended to be connected across a suitable source of power (not shown) which will generally be the conventional 110 volt single phase source provided for domestic use. The circuit from conductor **83** extends through the motor **14**, and then through a conductor **85** to a switch means **86** which in itself constitutes an important component of my invention and will be fully described herebelow. From switch means **86**, a conductor **87** is then connected through a switch **88** to conductor **84** to complete the circuit. In parallel with motor **14** the timer motor **51** is connected through conductors **89** and **89***a* in parallel with motor **14**. The timer controls the opening and closing of switch **88** either through a conventional cam system or through the type of pneumatic system described above in connection with sequence control mechanism **6**.

Referring now specifically to the structure of switch means **86**, it includes a casing **90** at the rear side **91** of which are connected a pair of contacts **92** and **93** at the ends of, respectively, conductors **87** and **85**. A bellows member **94** has its base **95** clamped to the casing, as shown, so as to be secured thereto. The front face **96** of the casing forms, together with the bellows **94**, a chamber **97**. The end **98** of the bellows carries a conductive member **99**, and when the bellows is extended to the left the conductive member **99** engages both contacts **92** and **93** thereby to connect the contacts together.

Centrally located in the end **98** of the bellows is an

opening 99*a* through which the chamber 97 may communicate with the interior 100 of the casing outside the bellows. The bellows is biased to a retracted position by a spring member 101 contained in a recess 102 formed in the back 91 of the casing, and on either side of the recess in the back of the casing there are provided openings, one of which is indicated by the numeral 103. When the bellows is in extended position the central enlarged portion 104 thereof in which opening 99*a* is formed abuts against the portion 105 of the casing back 91 in which the openings 103 are provided, and thereby closes the openings.

The front portion 96 of the switch casing has a centrally arranged opening 106 formed therein in which a manually operable member 107 is slidably positioned; preferably, the fit of opening 106 and member 107 is such as to permit the escape of little air if any from chamber 97 when chamber 97 is under pressure. The end 108 of member 107 engages portion 109 of enlarged part 104 of the bellows so that by pushing on portion 110 of the manual member 107 the member is moved to the left. The end 108 engages the end of the bellows to cause expansion of the bellows regardless of whether there is pressure in chamber 97 or not. A second opening 111 is formed in the front of the switch casing and communicates with a hose 112 which in turn communicates with the hose 47 leading to the compressor 45.

With this arrangement, when it is desired to start operation of the washing machine 1 of FIGURE 1, the switch 88 is closed and the contacts 92 and 93 of switch 86 are closed. Switch 88 may readily be closed by any conventional arrangement. For instance, if a conventional cam structure is provided this may be effected by rotation of dial 7 so as to effect manually a movement of the cam to close switch 88; or, if the switch is controlled by pneumatic pressure, it may be caused to open when pneumatic pressure is sensed and not when pneumatic pressure is not sensed so that in effect the switch 88 is normally closed. Assuming that the necessary operation has been provided to close switch 88, then member 110 of switch 86 is depressed, Depression of this member causes, as is mentioned above, connection of contacts 92 and 93 by connecting member 99.

At this point, the energizing circuit described above for the two windings 68 and 69 of motor 14 is provided, and an energizing circuit is also provided for the timer motor 51. When the motor 14 starts it of course also starts operation of the air compressor which in a matter of a second or less builds up to the desired pressure in hose 47 and the components to which the hose leads. One result of this is that the pressure within chamber 81 rises sufficiently to disengage contact 74 from contact 73 and thereby the start winding of the motor is de-energized so that the motor continues to run on the main winding 68 as is normally desirable in single-phase induction motors of the type provided for use in domestic appliances.

A further result is that air under pressure is supplied through hoses 47 and 112 into chamber 97 thereby building up the pressure in that chamber. It will be seen that with the bellows 94 in its extended position, as forced thereto manually by member 107, the opening 99*a* is closed by end 108 of member 107 and the openings 103 are closed by engagement with portion 104 of the bellows. Therefore, the chamber 97 is in effect a closed one and the pressure therein builds up rapidly. With spring 101 in the position shown, the pressure within the bellows causes the bellows to push against the spring, and the area of the end of the bellows is such that the force pushing the bellows to the left is greater than the spring force to the right. As a result, when member 107 is released the bellows remains in its extended position because, although air can escape through opening 99*a* once member 107 is released, it can only build up pressure in the very small spring recess 102 and cannot escape further due to the fact that part 104 of the bellows is providing a sealing engagement with part 105 of the casing. The bellows thus remains in its extended position in which it provides the desired result of connecting contacts 92 and 93 together electrically to complete the energizing circuit. Thus, as long as motor 14 keeps running the start winding remains de-energized and the main winding remains energized. Also, of course, as long as the circuit is completed the timer motor 51 is energized and causes a desired sequence of operations to be performed by sequence control 6 in response to the operation of the motor, i.e., water is introduced into the tub 4 of the machine of FIGURE 1, a washing action is provided, then an extraction, then more water and a rinse, and finally another extraction operation.

The motors 14 and 51 thus continue to operate until finally the end of the cycle is reached at which point the operation of the motor 51 causes switch 88 to open, either by the conventional cam approach or else by the release of pressure to a pneumatic device actuating switch 88. When switch 88 opens, this de-energizes both motor 14 and motor 51. The de-energization of motor 14 causes it to come to a stop and therefore the air compressor ceases to send air under pressure out through hose 47. As soon as the pressure goes down in chamber 97, the pressure of spring 101 causes the bellows 94 to be contracted thereby disengaging member 99 from contacts 92 and 93. Thus, even though switch 88 should thereafter re-close (if it is pneumatically operated, and because of the lowering of pressure therein), switch 86 has opened the circuit and the apparatus is de-energized until such time as another operation is required. Also of course the de-energization of the motor and the ceasing of operation of the compressor 45 bring the pressure in chamber 81 down so that contact 74 re-engages contact 73 in readiness for another operation.

It will be observed that the arrangement described in connection with FIGURE 2 provides a highly effective pneumatic control of the apparatus wherein, if motor 14 should stop operating for any reason, the apparatus will remain de-energized until the operator comes back to the machine. In addition it will be seen that the conventional centrifugal switch provided in single phase self-starting induction motors, which switch is a relatively expensive item, is eliminated by the inclusion in the pneumatic system of the apparatus for moving contact 74; just as in the case of a centrifugal switch, ceasing of operation of the motor 14 returns the contact 74 into a position of readiness for another operation. It will further be seen that the switch mechanism 86 has the effect of locking itself in by the air pressure provided by the motor once the motor has been started by the closing of the contacts in switch 86. In other words, any faulty operation of the motor 14 or of the compressor 45 will cause de-energization of the machine, and this control is effectively provided in an economical manner by use of a pneumatic system.

Referring now to FIGURE 3 of the drawing, there is shown a second embodiment of an improved pneumatic lock-in switch which may be used in the type of circuit shown in FIGURE 2 in lieu of the switch 86 shown therewith. The switch 113 shown in FIGURE 3 is provided with a casing 114 having a back portion 115 and a front portion 116. Contacts 117 and 118 are secured to the front portion and may be connected together by a conductive member 119 carried in a relatively soft grommet-type member 120. Member 120 in turn is secured on the stem 121 of a manually operable member generally indicated by the numeral 122 which terminates at its outer end in a handle 123. Stem 121 extends through an opening 124 formed in the front casing section 116, which opening is substantially larger than the stem 121. Preferably, stem 121 is co-axial with opening 124 as well as spaced relative thereto. A spring member 125 bears at one end against the front casing 116 at its other end against the grommet member 120, and is preferably positioned around the stem 121 as shown.

The back portion **115** of the casing may be provided with a V-shaped recess **126** which forms a female mating receptacle for the cone shaped end **127** of the grommet **120**. The front **128** of the grommet **120**, when member **122** is pulled axially outwardly by handle **123**, abuts against the edge **129** around opening **124** thereby sealing off the opening. At all other times there is free communication venting the chamber **130** formed within casing **114** to atmosphere through opening **124**. An opening **131** is provided in the back of the casing and is connected to a hose **132**; it will be understood that this hose **132** is, as in connection with hose **112** in FIGURE 2, intended to be connected to an air compressor so that air under pressure may be provided into chamber **130** when so desired.

It will be seen that when the member **123** is pulled straight outwardly two things occur. First, the front **128** of the grommet **120** seals off the opening **124** and in addition contacts **117** and **118** are connected together; thus, in the same manner as explained in connection with switch **86**, the switch member **113** may be used for completion of an energizing circuit for a motor driving a compressor which furnishes air under pressure through hose **132**. It will thus be understood that, when the handle **123** is pulled outwardly, very shortly thereafter air under pressure will be furnished into chamber **130** through hose **132** and the pressure therein will build up. Since the back surface **133** of member **119** has a substantially larger area subjected to the built-up pressure than the front surface **134** thereof there is a net force pushing the member **119** to the right as viewed in FIGURE 3, and this net force is sufficient to overcome the pressure of spring **125** and retain the parts in position with opening **124** sealed off and the contacts **117** and **118** connected together by the member **119**.

The machine of FIGURE 1, if provided with the switch **113**, may thus go through its proper cycle of operation as previously described. At the end of the cycle of operation there will normally be a switch, such as switch **88** of FIGURE 2, which opens the energizing circuit to motor **14** and thus stops the supply of air under pressure into chamber **130**. As soon as this occurs the pressure of spring **125** overcomes the air pressure and the member **119** is moved back to the position shown with end **127** of grommet **120** nested in mating recess **126** and with the contacts **117** and **118** disengaged.

It will also be observed that the structure of FIGURE 3, in addition to providing the same functions as the structure **86** in FIGURE 2, also provides a safety means for instantly shutting off the machine at any desired instant. This is effected by hitting or pushing the handle member **123** from any direction except in an axially straight-out direction. Because of the spaced relation of stem **121** within opening **124** any such force on handle **123** will cause the seal between gasket front **128** and edge **129** to be broken so that a vent is provided to atmosphere for the chamber **130** and the pressure therein drops accordingly. The movement of the member **119** held in gasket **120** also breaks the connection between contacts **117** and **118** so that the energizing circuit for motor **14** is opened and the entire apparatus ceases to operate. Because of the direction of the force of spring **125** and the configuration of grommet end **127** and mating recess **126**, the grommet will, regardless of the particular direction of the opening force on member **123**, return to its proper directly outward position shown relative to the front of the switch.

It will be seen from the foregoing that my invention provides a structure wherein a highly desirable and novel pneumatic operating system is provided for an article treating machine and, more particularly as illustrated, for a clothes washing machine. It will further be seen that by means of novel self-locking pneumatic structures, the system is made highly effective, economical, and safe.

While in accordance with the patent statutes I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an article treating machine: an article container; means for treating articles in said container; drive means operating said treating means comprising an electric motor; fluid compressor means operated by said motor; a circuit for energizing said motor across a source of power, said circuit including switch means comprising a pair of contacts connectable to control completion of said circuit, a movable structure for controlling connection of said contacts, said structure being biased to a first position and causing disconnection of said contacts therein, manual means for moving said structure to a second position, said structure causing connection of said contacts in said second position, means cooperably positioned relative to said structure to form a closed chamber therewith when said movable structure is in said second position and to form a vented chamber when said movable structure is in said first position; and conduit means connecting said compressor means to said chamber, said structure being formed so that the pressure within said chamber when said structure is in its second position and said compressor means is operating acts on said structure in opposition to the bias thereon to retain said structure in its second position.

2. In an article treating machine: an article container; means for treating articles in said container; drive means operating said treating means comprising an electric motor; fluid compressor means operated by said motor; a circuit for energizing said motor across a source of power, said circuit including switch means comprising a pair of contacts connectable to control completion of said circuit, a movable structure for controlling connection of said contacts, said structure being biased to a first position and causing disconnection of said contacts therein, manual means for moving said structure to a second position, said structure causing connection of said contacts in said second position, means cooperably positioned relative to said structure to form a closed chamber therewith when said movable structure is in said second position and to form a vented chamber when said movable structure is in said first position, said circuit further including a timer switch connected in series with said switch means; sequence control means for opening said timer switch after a predetermined amount of operation of said machine, said sequence control means including an electric sequence control motor connected in parallel in said circuit with said drive means electric motor; and conduit means connecting said compressor means to said chamber, said structure being formed so that the pressure within said chamber when said structure is in its second position and said compressor means is operating acts on said structure in opposition to the bias thereon to retain said structure in its second position.

3. In an article treating machine: an article container; means for treating articles in said container; drive means operating said treating means comprising an electric induction-type motor having a main winding and a start winding in parallel with each other; fluid compressor means operated by said motor; a circuit for energizing said motor across a source of power, said circuit including first switch means comprising a first pair of contacts connectable to control completion of said circuit, a movable structure for controlling connection of said first pair of contacts, said structure being biased to a first position and causing disconnection of said first pair of contacts therein, manual means for moving said struc-

ture to a second position, said structure causing connection of said first pair of contacts in said second position, means cooperably positioned relative to said structure to form a closed chamber therewith when said movable structure is in said second position and to form a vented chamber when said movable structure is in said first position; second switch means comprising a second pair of contacts positioned in series with said start winding and in parallel with said main winding, fluid-operated means controlling the position of said second pair of contacts, said second pair of contacts being separated when said fluid-operated means is subjected to a relatively high pressure and being engaged at other times; and conduit means connecting said compressor means both to said chamber of said first switch means and to said fluid-operated means of said second switch means, said first switch means movable structure being formed so that the pressure within said chamber when said structure is in its second position and said compressor means is operating acts on said structure in opposition to the bias thereon to retain said structure in its second position.

4. In a clothes washing machine: a receptacle assembly for containing liquid and clothes to be washed; means for washing clothes in said receptacle assembly; drive means operating said washing means comprising an electric motor; fluid compressor means operated by said motor; a circuit for energizing said motor across a source of power, said circuit including switch means comprising a pair of contacts connectable to control completion of said circuit, a movable structure for controlling connection of said contacts, said structure being biased to a first position causing disconnection of said contacts therein, manual means for moving said structure to a second position, said structure causing connection of said contacts in said second position, means cooperably positioned relative to said structure to form a closed chamber therewith when said movable structure is in said second position and to form a vented chamber when said movable structure is in said first position; and conduit means connecting said compressor means to said chamber, said structure being formed so that the pressure within said chamber when said structure is in its second position and said compressor means is operating acts on said structure in opposition to the bias thereon to retain said structure in its second position.

5. In an article treating machine: an article container; means for treating articles in said container; drive means operating said treating means comprising an electric induction-type motor having a main winding and a start winding in parallel with each other, and a pair of contacts connected in series with said start winding and in parallel with said main winding; fluid compressor means operated by said motor; fluid-operated means controlling said contacts, said fluid-operated means being arranged to open said contacts in response to pressure thereon and to close said contacts at other times; and conduit means connecting said compressor means to said fluid-operated means to provide pressure thereon when said compressor means is operating whereby said fluid-operated means opens said contacts to provide disconnection of said start winding during operation of said motor subsequent to starting thereof.

6. The apparatus defined in claim 1 wherein spring means are provided in said switch means to effect the biasing of said structure to its first position.

7. In a clothes washing machine: a receptacle assembly including a rotatably mounted clothes containing tub and washing means positioned within said tub; drive means for alternatively operating said washing means and rotating said tub at relatively high speed comprising an electric motor and a transmission connecting said electric motor to said tub and washing means; fluid compressor means operated by said motor; sequence control means for causing said transmission alternatively to cause spinning of said basket or operation of said washing means in response to operation of said motor, said sequence control means including an electric timer motor; a circuit for energizing both said motors across a source of power, said circuit including a timer switch in series with both said motors opened by said sequence control means at the end of a predetermined sequence of operation, and switch means in series with said timer switch including a pair of contacts connectable to control completion of said circuit, a movable structure for controlling connection of said contacts, said structure being biased to a first position and causing disconnection of said contacts therein, manual means for moving said structure to a second position, said structure causing connection of said contacts in said second position, means cooperably positioned relative to said structure to form a closed chamber therewith when said movable structure is in said second position and to form a vented chamber when said movable structure is in said first position; and conduit means connecting said compressor means to said chamber, said structure being formed so that the pressure within said chamber when said structure is in its second position and said compressor means is operating acts on said structure in opposition to the bias thereon to retain said structure in its second position.

8. Fluid-operated switch means comprising a pair of contacts movable to an engaged relationship and to a disengaged relationship; a movable structure for controlling connection of said contacts, said structure being biased to a first position and causing said contacts to assume one relationship therein, manual means for moving said structure to a second position, said structure causing said contacts to assume their other relationship when said structure is in its second position; and means cooperably positioned relative to said structure to form a closed chamber therewith when said movable structure is in said second position and to form a vented chamber when said movable structure is in said first position; said chamber having an opening adapted to be connected to fluid compressing means, said structure being so formed that a predetermined amount of pressure within said chamber when said structure is in its second position acts on said structure in opposition to the bias thereon to retain said structure in its second position.

9. The apparatus defined in claim 8 wherein said movable structure is formed at least in part as a flexible member, and spring means are provided for biasing said flexible member to its first position, said first position of said flexible member being in its deflated condition and said second condition of said movable structure being in its expanded condition.

10. The apparatus defined in claim 9 wherein said contacts are both stationary and said flexible member is a bellows, and electrical connecting means is carried by said bellows and engages both said contacts when said bellows is in its expanded condition and is removed from said contacts when said bellows is in its deflated position.

11. The apparatus defined in claim 9 wherein said flexible member is a bellows secured at one end, said bellows having a vent opening at one end thereof and a second opening at the other end thereof, manually operated sliding means extending through said second opening and engageable with said one end of said bellows whereby said manual means may be pushed to force said one end of said bellows away from said other end thereof, and sealing means positioned to close said vent opening in said second position of said bellows.

12. Fluid operated switch means comprising a pair of contacts adapted to be in a connected relationship or in a disconnected relationship, a bellows structure controlling connection of said contacts, said bellows providing one relationship of said contacts when in its expanded position and the other relationship of said contacts when in its deflated position, spring means biasing said bellows to its deflated position, manual means for moving said bellows to its expanded position, said bellows having a

first opening formed in the end thereof, said switch means including casing means cooperably positioned relative to the end of said bellows to seal off said first opening when said bellows is in its expanded position, said bellows being vented through said first opening when it is in its deflated position; said bellows having a second opening formed therein adapted to be connected to compressor means, said bellows being formed so that a predetermined pressure within said bellows when it has been moved to its second position retains said bellows in its expanded position in opposition to the bias of said spring.

13. The apparatus defined in claim 12 wherein said first opening is centrally located in said bellows ends, and said casing means is provided with an annular projection engageable with the end of said bellows around said first opening when said bellows is in its expanded position thereby to form a seal around said first opening.

14. Fluid-operated switch means comprising a pair of contacts having a first relationship wherein they are engaged with each other and a second relationship wherein they are separated from each other, a bellows member for controlling connection of said contacts, said bellows being biased to a deflated position and providing one of said relationships of said contacts therein, said bellows having a first opening provided in one end thereof, manually operated sliding means positioned within said first opening and engageable with the other end of said bellows for forcing said bellows to its expanded position, said bellows providing the other relationship of said contacts in said expanded position, said other end of said bellows having a second opening formed therein, casing means positioned relative to said other end of said bellows so as to seal said second opening when said bellows is in said expanded position, said second opening providing a vent for said bellows when said bellows is in its deflated position, said bellows having a third opening formed therein through which the interior of said bellows is adapted to be connected to a source of fluid pressure, said bellows being formed so that upon the presence of a predetermined fluid pressure therewithin when said bellows is expanded said predetermined pressure acts on said bellows in opposition to the bias of said spring to retain said bellows in its expanded position.

15. Fluid-operated switch means comprising a pair of contacts adapted to be connected together in a first relationship thereof and to be electrically separated in a second relationship thereof, a casing member having a

first opening formed therein, manually movable means extending through said first opening, means carried by said manually movable means for providing one relationship of said contacts when said manually movable means is pulled outwardly to a first position, spring means biasing said manually movable means inwardly to a second position, said manually movable means providing the second relationship of said contacts when out of said first position, means carried by said manually movable means for sealing said first opening when said manually movable means is moved to its first position, said carried means having a side with a relatively large area susceptible to fluid pressure in said casing member facing opposite said opening, said casing member having a second opening formed therein adapted to connect the interior of said casing member to fluid pressure means, said carried means being so formed that upon a predetermined pressure within said casing member when said manually movable means is in its first position the pressure on said carried means retains said manually movable means in its first position in opposition to the bias thereon by said spring.

16. The apparatus defined in claim 15 wherein said sealing means comprises a gasket engageable with said first opening to seal said first opening when said manually movable means is moved to its first position, and said carried means is secured on said gasket.

17. The apparatus defined in claim 15 wherein said manually movable means extends through said first opening in spaced relation thereto and coaxially therewith whereby any force on said manually movable means in any direction except axially outward moves said sealing member away from said first opening to vent the interior of said casing member.

18. The apparatus defined in claim 17 wherein said gasket has the end thereof farthest from said first opening formed substantially as a cone, and said casing member adjacent said gasket end is provided with a mating cone shape thereby to center said manually movable means in said first opening despite the spaced relationship of said manually movable means to said first opening.

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